THE MODEL ENGINEER

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Smoke Rings

Model Engineers and the Home Guard

I HAVE no doubt that many of my readers have either actually joined the Home Guard in their locality or have been seriously considering in what way they could collaborate by offering their technical skill and the service of their home workshop. I have already published some information showing that model engineers are helping by the production of dummy ammunition for instruction purposes and by the construction of certain items of needed equipment. A letter from a distinguished correspondent puts this rather casual kind of service in a new light. Having been asked to join the local Home Guard battalion he agreed to do so on the understanding that he was appointed the official armourer. This suggestion was accepted and he has since carried out a considerable amount of useful work with general approval and satisfaction. He writes :—" Some knowledge of firearms is necessary. Books can still be bought giving details of various types of rifles, automatic rifles and machine guns. Some books can be supplied by the adjutant. The types of job one gets are numerous ; for instance, broken extractor and ejector springs, bent foresight guards, broken firing pins, stopped-up barrels, re-sighting small bore rifles, the production of dummy ammunition, the designing and production of tripods. Other problems involve the making of special tools, such as screw-ended rods for withdrawing obstructions in the barrel, generally broken 'pull-throughs.' One of the most interesting and tricky jobs I have tackled was that of a .22 which was shooting erratically. Examination showed that one of the five ' lands ' had broken about 3/32nds down. The trouble was cured by stripping the barrel, passing it through the hollow mandrel of my lathe, and boring out the mouth to give a plain bore for the last $\frac{1}{8}$ in. The rifle then shot perfectly." This extract from my correspondent's letter shows clearly that there is much work which the model engineer " armourer " can do. I do not know if the rating of armourer is adopted in many Home Guard battalions, but it certainly seems that such an appointment would be fully justified, and that many model engineers could fill the post with advantage, if given the opportunity. It would particularly suit those, who, though having the skill and the equipment, are unable to undertake the more continuous work of quantity production of munition parts.

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A Society Link up

THAT very enterprising body, the Kent Model Engineering Society, has entered into what it terms, in a topical phrase, a tri-partite pact. It has called into consultation the Croydon Society and the Bromley Society, and an arrangement has been entered into whereby the three societies will pool their resources and their meeting programmes, for the period of the war. The headquarters will be at the Kent Society's premises at Sportsbank Hall, Catford, where regular meetings will be held at 11 a.m. on Sundays, during the winter period. An evening meeting will be held occasionally for those who are unable to attend on Sundays. The Kent Society has been allowed the use of a tennis-court for the erection of their running track, which is now available for loco. enthusiasts at any time by arrangement. Three gauges are in use : 5 in., $3\frac{1}{2}$ in., and $2\frac{1}{2}$ in. The track is situated in Crantock Road, Catford, and several enjoyable meetings there have already taken place. Members of other London Clubs will be welcome with their locos. if they wish to run them. Full information will gladly be supplied by the Hon. Secretary, Mr. W. R. Cook, 103, Engleheart Road, S.E.6.

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Workshop " At-Homes "

DURING a recent visit to an engineering factory well-known to model engineers in peace time but now engaged entirely on war work, I was interested to learn that an arrangement was in force whereby the workers in each department were " at home " at specified times to their fellow-employees engaged in other departments. The purpose of this was that all the employees might obtain a general view of the whole output of the factory, and so come to understand how the " bits and pieces " they themselves produced in their own shop were eventually incorporated with the products of other departments into the engine or weapon which was finally dispatched to do its service with the fighting services. They learned how the castings they machined were made, and how the tools and gauges for the machining were produced. They saw how their work was inspected before being passed into the stores, and they saw the completed product tested before being packed and dispatched. Each employee through this intercourse realised the collective importance of his or her own particular job, however small or simple it might be in itself, and there is no doubt that the team spirit of the workers has gone up enormously.

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Model Speed Boats in U.S.A.

WHEN sending me a brief report of the recent Invitational Model Power Boat Regatta held at Chicago, Mr. Howard Scott enclosed a photograph of a steam-powered hydroplane built by Mr. Mike Lucardi, of Detroit. Although in official tests this boat has only recorded a speed of 45 m.p.h., I am told that unofficially she has done close on 58 m.p.h. No doubt we shall hear more of this boat in due course, but meanwhile this is a breath-taking performance, and I note with special interest that it goes to the credit of steam.

Percival Marshall

"MOLLY" A $3\frac{1}{2}$-in. gauge L.M.S. 0-6-0 Tank Locomotive

By "L.B.S.C."

Reverse Lever

THE reverse lever shown in the illustrations is practically "scale" size and in the "scale" position (I love that word about as much as Adolf and all his works, which is saying plenty !) but two alterations were found necessary to fit it on "Molly." On her big sisters, the fulcrum pin is in a block attached to the inside of the frames, and the lever is cranked outwards to fit into a quadrant on a stand bolted to the little splasher over the trailing wheel, but on the small engine this would not be very strong ; also I like to arrange matters so that the running-boards and splashers can be removed bodily in case of emergency, as plenty of things happen on small railways that are unheard of on full-sized ones ! I have therefore extended the stand downwards sufficiently to carry the fulcrum pin, and set it over to suit the lever, so that the whole bag of tricks is self-contained, and can be bolted direct to the inside of the frames.

The latch for holding the lever at any point in the quadrant is also different from full-sized practice. On the big engines there is a small section of the lever just above the quadrant, which is made wide enough to span the notches. This has a groove cut in each side, and the latch fits the grooves, thus being central with the lever. A small edition of this arrangement would be a dickens of a job to make and fit properly, and very fragile when completed, so I have substituted another latch-block, latch, and operating rod of the simple type which I have found easy to make and perfectly satisfactory in use. A minor variation from the big engine is the position of the connection on the lever for the reach rod, which is a little higher up. This is necessary in order to give the extra movement to the weighbar shaft consequent on the use of links longer than "scale," which are needed for my pet arrangement of ports and valves ; but that is nothing to fret over !

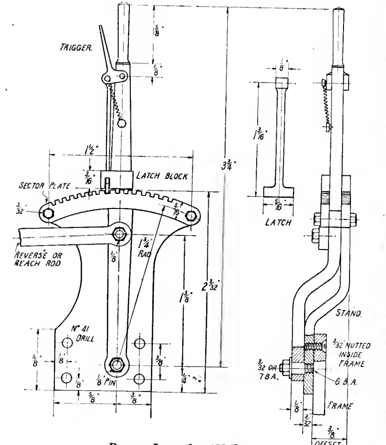
Stand for Lever

This is made from a piece of 3/32-in. mild steel plate, bright for preference, and measuring approximately $1\frac{3}{4}$ in. by $2\frac{1}{2}$ in. Note when marking it out, that the curved top is struck to a radius of $1\frac{3}{4}$ in. plus half the width of the sector plate, that is 1 27/32 in. Saw and file to outline ; then put a "set" in it as shown, which can easily be done, by a little careful juggling, in the bench vice. When you have got this right, the fulcrum point of the lever can be marked off, drilled and tapped 6 B.A., and the bolt holes drilled. The curved sector plate is then marked off on a piece of the same kind of steel, cut out, and attached to the stand by 3/32-in. bolts, with spacers between plate and stand. These spacers are made by chucking a piece of 3/16-in. round rod in the three-jaw, centring and drilling No. 41, and parting off a couple of slices a full $\frac{1}{8}$ in. thick. Don't cut any notches yet, leave them until the lever is fitted.

Lever

The lever can be made from a $4\frac{1}{4}$-in. length of $\frac{1}{8}$ in. by $\frac{1}{4}$ in. flat mild steel. Either chuck it truly in the four-jaw, or take Mr. Alexander's tip and mount it between centres, and turn the handle—but not in the way Mr. Mussolini's musicians turn it, although the engine has "monkey" glands ! Next, file up the taper, then "set" it over to suit the bend in the stand, after which the holes for the fulcrum pin and reach rod pin can be marked off and centre-popped. The former is drilled No. 32 and reamed $\frac{1}{8}$ in. The latter is drilled No. 44, tapped 6 B.A., and countersunk slightly on the side of the lever next the stand, if you prefer a stud to a setscrew for the reach rod eye. The trigger is sawn and filed to shape shown in sketch, from a piece of $\frac{1}{4}$-in. by 5/16-in. steel rod about $\frac{5}{8}$ in. long. File or mill a $\frac{1}{8}$-in. slot longitudinally across the bottom, so that the trigger fits nicely on the lever. Drill the pinholes No. 53, drill a No. 51 hole in the lever, and attach the trigger by a bit of 1/16-in. silver-steel or 16 gauge spoke wire squeezed through the lot and filed off flush.

The latch is filed up, complete with rod and eye, from a piece of $\frac{1}{4}$-in. by 5/16-in. steel. The sketch shows the shape and size ; note that the bottom of the latch which engages with the notches in the sector plate, should be filed wedge shape, to prevent the lever rattling when the engine is



Reverse Lever for "Molly."

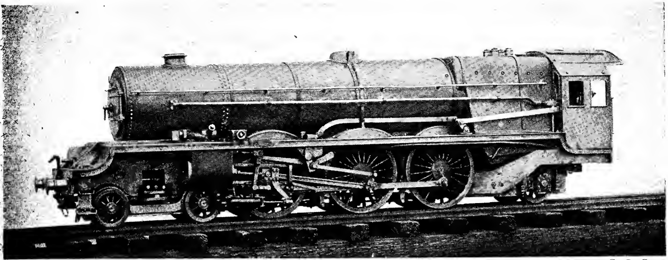


Photo by] [*C. J. Grose*

A $2\frac{1}{2}$-in. gauge "Princess Royal" with four cylinders and all details. Note working vacuum pump.

running. The latch may be casehardened, as previously described for other parts. The eye is inserted in the outer end of the trigger, and pinned as described above; but leave enough of the pin sticking out, to take the spring.

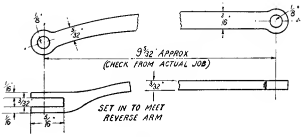
The latch block is a piece of steel, 3/16 in. by 5/16 in. section, and 11/32 in long. A $\frac{1}{8}$-in. slot is milled or filed in it, to allow it to fit on the lever; and the best way to do this is to mill the slot as described for valve gear forks, in the end of a piece of rod long enough to clamp under the slide-rest tool holder, and cut to length afterwards. Then cross-slot it a bare 1/16 in. from the solid end, as shown in the drawing, the width of slot being 1/16 in. Put the latch block temporarily in position on the lever over the latch, but don't pin it yet; it must be properly adjusted when the lever is fixed.

Erection and Assembly

To erect the lever assembly you will have to take the screws out of the trailing hornstays and let the wheels drop down a bit, but that is only a few minutes' job at the outside. Now clamp the stand to the frame temporarily on the *outside*, in such a position that the bottom of the stand is $\frac{3}{8}$ in. below the top of frame, and the fulcrum pinhole is exactly 4 in. from the rear end of frame, that is at the inside of the buffer beam. Now poke the No. 41 drill through the bolt holes in the stand, and carry on right through the frame; file off the burrs inside, and then remove the stand and countersink the holes on the outside of the frame.

To attach the lever to the stand, turn up a little stud from $\frac{1}{4}$-in. silver steel, one end is turned down just a shade for $\frac{1}{8}$-in. length and screwed 6 B.A. The other end is turned down to 3/32 in. diameter for a bare 5/16-in. length, and screwed 3/32 in. or 7 B.A., leaving a plain piece in the middle a full $\frac{1}{8}$ in. long. Slightly countersink the tapped hole in the stand, on the side next the frame; screw the stud in tightly, rivet over the end into the countersink, and file off flush. A similar stud can be made and screwed into the reach rod pinhole in the lever, if you so desire, or a setscrew may be used instead. Take off the sector plate, put the lever in position with the fulcrum pinhole over the stud in the stand, secure it with a nut and washer, and replace the sector plate. The lever should slide easily between the sector plate and the stand, but should not be sloppy anywhere, or else when the engine is running, it will rattle what my niece used to call "something awful." They do in full size—I'll say so!—and we often used to stick bits of wood and anything else handy, between the latch and the notches, to get a little peace and quietness in the cab when running at any speed. I recollect one occasion when the latch on one of the old Kitson 0-6-0's broke clean off just after passing Norwood Jct., and the lever flew into full gear with a crash that would have started all the sirens going, if there had been such things in those days. However, nothing worse happened, so we just breathed a prayer of thanksgiving in railroad Esperanto, and went from East Croydon to Lewes in full gear with just a crack of regulator; but there wasn't any coal-money earned on *that* trip!

Now adjust the latch block on the lever until it just clears the top of the stand and sector plate when the lever is moved back and forth, and secure it by drilling a couple



Reach rod.

of No. 53 holes through the lot, and driving in bits of 1/16-in. wire. If the holes are countersunk slightly, the ends of the wire hammered down and filed off flush, they will be practically invisible, and make a neat fixing. Set the lever exactly vertical, and note where the latch comes; mark the spot, and carefully file a notch across stand and sector plate with a watchmaker's file, or a key-cutter's warding file. Push the lever forward until it just clears the spacer, mark position of latch, and repeat the notch-cutting ceremony; then pull the lever right back, and "ditto repeato." Now, will Inspector Meticulous kindly get out his notebook and jot this down: I have deliberately omitted to dimension the notches. On the full-sized engine, there are seven each side of the middle one, equally

spaced. If you are deft at filing small neat notches, put them all in. If you are at all ham-fisted, put in three or four only, a little larger in size. They would look far better than a lot of little ones cut all straggly, out of which the latch would jump at the first available opportunity. The latch, of course, must fit the notches nicely, whatever the size of the latter. Although it will usually fall into the notches by its own weight, it is advisable to fit a spring to hold it there, and this can be done by drilling a No. 55 hole in the lever about half way between the trigger and latch block, tapping it 1/16 in. or 10 B.A., and putting in a screw. A small spring, wound up from No. 30 gauge steel wire around a piece of 1/16-in. steel, is slipped over this screw and the extended pin in the trigger, and will effectually do the doings, besides looking neat.

The complete assembly is now placed in position on the inside of the frame, and secured by four 3/32-in. or 7 B.A. countersunk screws ⅜ in. long, put through holes in frame and stand, and nutted inside; after which, the wheels can be replaced and the screws put back in the hornstays. If the lever is correctly installed, the inside of the upper part will line up with the outside of the frame, as shown in the endwise view of the whole assembly. The drawings show the lever arranged for a right-hand drive engine; if you prefer left-hand drive (I do) then all you have to do is to bend the stand and the lever the other way, and fix the assembly to the left-hand frame.

Reverse or Reach Rod

A piece of ¼-in. by 3/32-in. mild steel strip about 10 in. long, will be needed for the reversing rod between the lever and the reverse arm on the weighbar shaft. The front end is forked; and to make the fork, first braze a little block of steel about 3/16 in. thick, ¼ in. wide, and ⅜ in. long, to the side of the rod, which will thicken it up sufficiently to form the offset fork. Next cross-drill through the block with a No. 32 drill, then slot it as described for coupling-rod knuckles, etc., after which it is filed up to shape, similar to the forks of the eccentric rods. The other end of the rod should not be drilled until the rod is bent to the correct amount of "set" to line up with the lever and the reverse arm. You can best do this by trial and error on the actual engine, the "set" being made close to the forked end, as the straight part has to lie close to the boiler, passing between that and the side tank. After the set is made, put the lever in the middle notch of the quadrant, and the valve gear in mid-position, when the reverse arm on the weighbar shaft should stand exactly vertical. Measure the distance from the centre of the pinhole in the reverse arm, to the centre of the stud on the lever, which gives the exact length of the reach rod, between pinholes. On my drawing of the "works" it comes out at 9 5/32 in., but on the actual job it may vary a shade either way, so it is best to get the dimension from the engine itself.

Mark out the distance on the rod, drill the hole for the eye No. 32, and shape the end with a Wilmot filing jig as before. The rod can then be nicely tapered off—don't overdo it and make it weak, a 1/32-in. taper is plenty—the eyes reamed out to ⅛ in., and the rod fitted. The lever end merely fits over the stud and is secured by a nut; the front end can be fixed by a little bolt made from ⅛-in. silver-steel, turned down to 3/32 in. each end for neatness sake, and nutted. Use plain washers under the nuts. The lever should now move the gear easily from forward to reverse in any position of the motion, unlike several engines I have had for repair and overhaul, which would only reverse when the links were about vertical, and even then, the lever required joggling about to make it operate. That would be a nice state of affairs in full-size practice!

How to Set the Valves

Turn the chassis upside down, and rest the buffer beams on a couple of blocks of wood, or something equally effective, high enough to let the lever clear the bench. Take off the steam chest cover, put the lever in full forward gear, and turn the wheels by hand, watching the amount of port opening. If this is equal at both ends of the movement, the valve spindles are O.K., and no adjustment is required. If not, take out the pin connecting the valve crosshead or fork to the short link, and adjust length of rod by turning the fork on the spindle. If the eccentrics are turned solid with the axle, or with the middle part of it as recommended, and set in proper relation to the cranks, this adjustment should be all that is needed; and if each main crank is placed in turn on the dead centres, both front and back, the corresponding port should just show as a tiny crack at the edge of the valve lap, with the lever either in fore gear or back gear position. If no crack shows at all, the valves are too long, and need a tiny bit filed off each end. If a big opening appears, say 1/32 in. or so, the valves are a little too short, and may be easily lengthened by silver-soldering a tiny bit on each end. Be absolutely certain that both laps are exactly the same distance from the cavity, or else the exhaust beats will be syncopated.

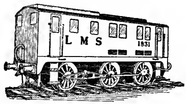
If separate eccentrics are used, simply put the main cranks on each dead centre in turn, and adjust the eccentrics on the shaft until you get the setting described above. The eccentrics can be temporarily tightened in any position relative to the cranks, whilst you are getting the valve spindle adjustment made for equal port openings, and correctly adjusted to crack the ports on dead centres afterwards. Treat valves as above, if too long or too short.

Members of the "Ancient Order of No-Leaders and Anti-Expansionists" will get a fearful shock if they put the lever in mid-gear and turn the wheels. However, you know the old saying about "the proof of the pudding." Well, I have here a 2½ in. gauge Pacific built nearly eight years ago. She has launch links, the same setting as above, and about the same port openings in mid-gear. Once she is away, with three passengers up, you can bring the lever right back to middle, and run on the lead steam alone at a terrific speed. A high official in the locomotive dept. of the Southern Railway did it, and nearly burned up the brake shoes on my test car, applying the brakes against steam, trying to make her puff with the lever in that position. And yet some folk aver that steam expansion in little cylinders is "pure rubbish"!

Making Holes in Thin Sheet

It is often a matter of difficulty to cut small, neat holes in thin sheet brass or steel, or in paper gaskets. The following simple method is most efficient.

Take a twist drill of the size of the hole required, and square off the end of the *shank* on a grindstone. Now chuck the drill in a drilling-machine, and, taking a small block of steel, drill a hole into it. Do not move the block from its position on the drilling table. The drill is now reversed in the chuck, so that the squared shank is pointing downwards. We have now, in effect, a punch and die. By placing the substance to be punched upon the block, and by smartly pulling down the drill with the feed lever, a neat and clean hole will be made. The method may be used on almost any substance, including fibre, leather, paper, or thin metal; in fact, the writer has punched holes in spring shim steel in this way. Care must be taken, however, not to attempt the process with anything but thin metal, otherwise the drilling machine may be strained.—"TURNER."



1831 . . .

★A $3\frac{1}{2}$-in. gauge I.C. Engine-driven Locomotive

By Edgar T. Westbury

Lubrication System

THE elements of the lubrication system have already been outlined in the general description of the engine, and alternatives to the recommended methods of oil supply discussed, for the benefit of readers who may prefer to simplify them. As yet, there are comparatively few model petrol engines fitted with pump lubrication, but my own experience suggests that the importance of correct and automatic lubrication on any engine intended for continuous running, makes the slight additional work of fitting an oil pump well worth while. As in the case of steam locomotives, the advantages of mechanical lubrication are only in doubt in the minds of those who have never tried them. It may be mentioned, in justification for the pains taken in this direction, that when, after making some experiments with tiny oil pumps, I decided to incorporate one as an integral part of my 15 c.c. speed boat engine design some years ago, the idea was ridiculed in certain expert circles; but all those who have built and used the design of engine in question have fully endorsed my views on the practical value of the oil pump.

It is, however, in the present case, possible to build the engine without the pump, and add it later on if considered advisable, though this means depriving the engine of the advantages of the pump during the period in which it is most likely to be specially useful—that is during running-in. So long as some satisfactory means of *continuous* oil supply is provided as an alternative, however, and properly used, no trouble need be anticipated. Mr. Ripper's 15 c.c. engine, which has a simple suction oil feed to the main and big-end bearings, has been working quite satisfactorily in the locomotive all through the past season. It should, however, be pointed out that "splash" lubrication, in which the oil sump is simply filled up to such a level that the big ends will dip in it as they rotate, cannot be relied upon for continuous running, unless a specially designed form of sump is used (as in the case of THE MODEL ENGINEER road roller, for instance).

Oil Pump Design

The form of oil pump employed is one which is well known and very extensively used for lubricating I.C. engines, and if reasonably well made, will work with complete reliability for a very long time with no attention whatever. It is less reliable than a plunger pump, in respect of constancy of quantity and pressure under varying conditions, and I have considered it to be less suitable than the latter for use with certain types of engines, where these points are of great importance. The engine now under consideration, however, is not critical in its requirements, and on the strength of actual experience, I have no hesitation in recommending the use of the simple gearwheel pump for keeping it efficiently lubricated.

The arrangement of the pump is shown in Fig. 78, which shows it in position on the face of the timing cover, immediately below the starter dog end of the crankshaft. It will be seen that the oil suction is taken, by way of a short suction pipe, from a banjo union at the side of the sump, and delivery is by way of an elbow and union to a service pipe which passes round to a connection under the centre of the camshaft, leading to the main bearings. As will be seen in the sectional view, the pump is driven by a spur gear from the timing pinion on the crankshaft, this gear being the same size as that on the camshaft, so that the pump runs at half engine speed. The duty entailed in driving the pump is extremely light, and a much less robust form of gearing would have been quite sufficient, but in the particular circumstances there has been no need to cut down weight, and the use of a narrower gear face for the pump gear might result in local wear of the crankshaft pinion, which would affect the efficiency of the timing gears in the course of time.

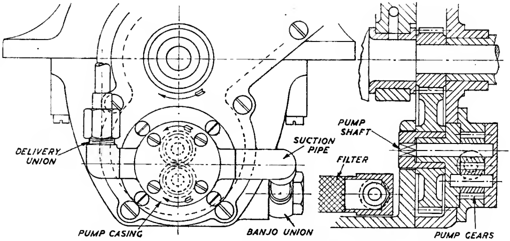


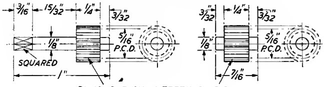
Fig. 78. Face view and section of oil pump, assembled in position on the lower part of timing case.

Although access to the pump cannot, in any circumstances, be very easy while the engine is installed in the chassis, it has been considered desirable to make provision for removing the pump from the face of the timing case without dismantling any other part of the engine. Obviously this is an impossibility if the spur gear is rigidly attached to the shaft, as a hole sufficiently large to withdraw it through the timing case would be undesirable; a form of

* *Continued from page* 327, "*M.E.*," *October* 23, 1941.

"floating" gear is therefore employed, which drives the pump shaft through a square and socket, so that removal of the pump is a very simple matter, and the gearwheel is left in position in the timing case. Its location is preserved by means of a hole in the end face of the sump housing, which need not necessarily fit the gear bush well enough to form a bearing, but only to prevent it dropping when the pump is removed, in such a way as to cause difficulty in re-assembling the latter. This form of drive also provides considerably more bearing area for the pump drive shaft than would otherwise be possible (unless the end space taken up by the assembly were considerably increased), and relieves this bearing of all side thrust caused by the gear drive. The latter is often the cause of a good deal of trouble with small pumps of this type, as wear of this bearing causes leakage of oil, unless a separate oil gland (which is difficult to accommodate, and may itself become a source of trouble) is fitted. In this pump, the driving gear takes its bearing on the *outside* of the pump shaft bearing, while the shaft, free of all side thrust, runs on the *inside*.

The gears recommended for this pump are 5/16 in. pitch diameter by ¼ in. width of face, which, if cut 32 diametral pitch, to correspond with the pitch of the timing gears, works out at 10 teeth, and the diameter over the tips of the teeth is exactly ⅜ in. Any small gears which correspond more or less to these dimensions may be employed, and discrepancies in the diameter of the gears may be compensated by altering the face width. It should be noted that the output of the pump (per revolution) is decided by



PINIONS EACH 10 TEETH, 32 D.P.

Fig. 79. Details of pump pinions.

the volume of the spaces left between the teeth, and thus a coarse pitch favours output efficiency; pinions in some pumps of this type have only six teeth. But in the present case, there is no special reason to design the pump for maximum output, as there is no difficulty in getting it to deliver the amount of oil required by the engine.

As the large spur gear which drives the pump meshes directly with the pinion on the crankshaft, it will rotate in the opposite direction to the latter, that is, anti-clockwise, viewed from the face of the timing case. I trust that no readers will take the trouble to write and tell me that the pump is running in the wrong direction, or conversely, that the suction and delivery pipes are on the wrong sides, for the order of rotation adopted. It is a common fallacy among those who have not had practical experience with gearwheel pumps than the fluid passes right through *between* the gears, on the tangent of the contacting pitch circles; but in actual fact, this is just what it does not do, as the teeth of the pinions occupy all the available space at this point, so that the fluid is displaced, and fills the tooth spaces as they pass round the *remote* sides of the cylinders in which they rotate.

Although this point is a very elementary one, I have thought it worth mentioning, because I have encountered many instances, among people who should know better, where there is not merely ignorance, but a disposition to argue over it. On one occasion I was given instructions by a person in authority to connect up a pump in a manner I knew to be wrong, but when I attempted to explain this I was very promptly told "not to be an idiot." Orders were therefore obeyed to the letter, but the surprise of the person concerned, when the pump was tested out, can be better imagined than described! I believe, however, that even then he suspected that there was some hocus-pocus about the business, and being the sort of person who never climbs down, he never forgave me for knowing better than he did.

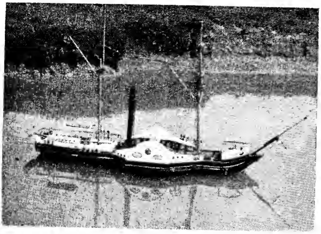
It may be mentioned that where gearwheel pumps are found to deliver too much oil for a particular engine, the simplest remedy, in most cases, consists of cutting down the width of the gears and the gear housing, by machining them away as required. This is a more satisfactory method than by-passing oil through an automatic or manually adjusted valve, as it avoids any possible erratic action, and is proportionally effective at all engine speeds. I have encountered cases in engine research work where an over-estimate by the designer, of the pump capacity required, has resulted in the gear wheels being gradually pared away in the test shop until they looked as if they were stamped out of tinplate! Such drastic measures will not, I hope, be called for in the present case, but I mention the method just in case some constructors of this or similar small pumps happen to encounter such a problem. Needless to say, a pump having *insufficient* capacity could only be dealt with by fitting longer or larger diameter gears (the latter being, of course, impracticable if the pitch centres have already been determined).

Construction of Pump

The number of parts entailed in constructing the pump is not large, and the task of machining them is by no means as formidable as some readers may imagine, provided that proper methods are adopted. Fig. 79 shows the pump gears, and it will be advisable to start off by making or obtaining these first, because any discrepancy in their specification will obviously affect the dimensions of the other parts. Steel gears are recommended, though I anticipate that they would give quite serviceable wear if made in brass. They may with advantage be turned integrally with the ⅛-in. shafts, but it will, in many cases, be more convenient to fit separate shafts; that which takes the drive must be very firmly pressed in or otherwise fitted to the gear, so that there is no risk of its slipping, but the other is not so important; both gears must, of course, be dead concentric with the shafts. In view of the small size of these shafts, and the difficulty of case-hardening them without distortion, silver steel may be used and left in its original condition, without any heat-treatment. The square on the end of the driving shaft should be very carefully filed or machined, and some readers may find this a rather delicate operation. It may, however, be noted that the use of a simple filing rest, such as that described some time ago in THE MODEL ENGINEER, enables work of this nature to be carried out very simply and expeditiously. It is most essential, however, that if an appliance of this nature is used, the shaft should first be set to run dead truly in the lathe.

Although there should be no question of the correctness of the external and pitch centre dimensions of properly-made pinions, it is advisable to check these carefully before fitting them to the casing, as any discrepancy in their size would have to be allowed for in machining the latter. The outside diameter of the pinions can, of course, be measured easily by means of a micrometer; to check up on the pitch centres, it is advisable to set one of them up on a true mandrel running in the lathe, the other being allowed to run freely on a stud suitably held in the tool-post. Set the latter dead parallel with the lathe axis and adjust the meshing depth by the cross-slide feed until the pinions run freely and sweetly. By measuring over the two shafts with a micrometer, and deducting half the radius of each shaft, the exact centre distance can be truly ascertained.

(*To be continued*)



The model P.S. *William Fawcett*.

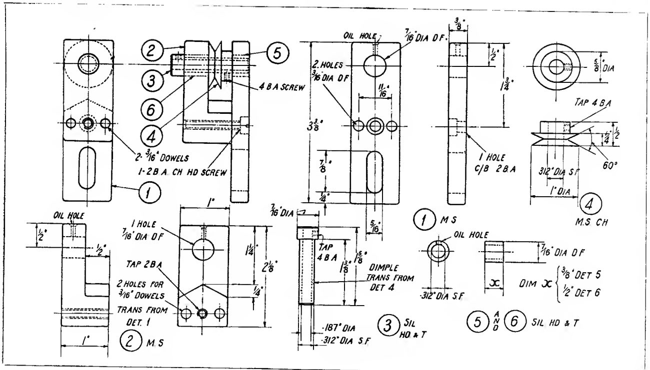
again, I was very fortunate in obtaining all the necessary information from the Science Museum, thereby enabling me to rig her correctly and finish her in the proper colour scheme. The paddles are operated by an electric motor with a 15-1 gear reduction to the paddle shaft; one portion of the deck is removable so as to get at plant and batteries. On the water the paddles give a very realistic wake, but the elaborate top hamper and rigging are inclined to make her roll in a wind, the tug being a much more sturdy type of model to use in rough weather, and less liable to get damaged.

This year, after a break of five years, I have started on yet another ship model, a $\frac{1}{4}$ in. to 1 ft. scale model of Admiral Byrd's exploration ship *Bear of Oakland*. I have partly completed the hull, the structure of which is similar to my previous boats, but instead of using paper as a covering I am planking it in with 3/16-in. thick sheet balsa wood, and so far the results appear to be very promising. The length of the hull is 4 ft. 2 in., beam $7\frac{1}{4}$ in. When this model is complete I should be pleased to give further details of it, as well as a description of its performance; but it will probably be some time before this is ready for a trial, as I get little spare time for modelling activities these days.

At home (in Sussex) I have a small pond measuring 30 ft. × 25 ft. on which I test my models, so if any reader is interested I should be pleased for him to bring his craft along by appointment. I should also be pleased to show them my work.

A Face-Plate Milling Fixture

By G. D. R.



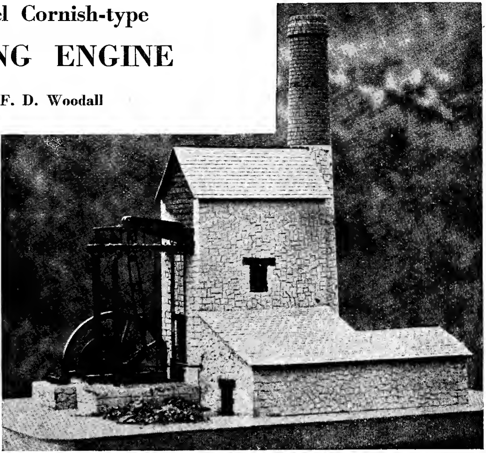
I HAVE found this gadget very useful for several awkward milling jobs, such as the outside of petrol engine crank-case, barrel, con.-rods, etc.

In use, it is clamped anywhere on the faceplate, with the job fixed on boring table. Alternatively, this can be attached to an angle-plate on table for all sorts of odd shapes held on face-plate or in chuck. In my case, this is driven by a small motor hinged at back of bench, to take up belt slack. Varying height for the cutter is made by engaging back-gear and revolving head-stock pulley. Front bearing should be tightened to prevent movement.

I think the sketches show it as a straightforward proposition. The only point of note is that details (1) and (2) should be screwed and dowelled; set up on face-plate and bored for bushes.

A Model Cornish-type
WINDING ENGINE

By F. D. Woodall



Mr. Woodall's model of a Cornish-type winding engine.

THIS article may be considered as a continuation of one that was published in the "M.E." for April 19th, 1941, on a "Model Cornish Pumping Engine." Besides the non-rotative pumping engines, the nineteenth-century Cornish mining engineers made extensive use of two types of rotary beam engines. One was the stamps engine directly connected to a battery of square-headed stamps, a somewhat crude plant, but the forerunner of the modern Californian round-headed stamps. The other was the winding engine locally known as a Whim. These were usually built with the drum and crankshaft outside; the engine-house being not unlike the house of a pumping engine. It should be pointed out, however, that a large winder would be about the size of the smallest pumping engines. The arrangement of the drums varied considerably, some engines being geared, while others had the drum on the crankshaft or on a short shaft driven from the crank by means of a drag-link and follower crank, an early form of flexible coupling to compensate misalignments in the bearings.

The hoisting was done in egg-shaped iron buckets known as kibbles, which were literally dragged up the mine shafts, without any form of runner or guide, although a writer in those days described them as "gliding like bottles." Following upon the introduction of steel cable in place of chains and gigs with runners engaging wooden guides in the shafts, a much increased winding speed was permissible, which the single-cylinder (and sometimes single-acting) whim engine could not cope with. The beam winding engine had thus become obsolete by 1880 or so. This was one of the reasons why the writer had greater difficulty in obtaining data before building the model than when building the pumping engine.

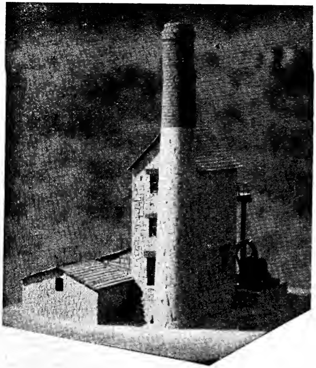
The chief sources of information were some old engines standing idle near East Pool Mine, one of which was illustrated in the "M.E." for September 12th, 1935, by H. W. Cole (the writer wonders if he is still interested in early engineering). In the past, a number of engines had been re-erected as rotary pumping engines in the China clay pits in the St. Austell district; a certain amount of useful facts were obtained from these, but nothing relating to the drums or braking gear.

The model is constructed to the same scale as the pumping engine, viz. 1 in. = 5 ft., and represents an engine of 7 ft. 6 in. stroke. The drum is on the crankshaft, like some of the later-date engines. A point in the construction that is peculiar, but accurately copied from full size practice, is that the flywheel and one side of the drum are not keyed to the shaft but are both keyed to a large cast-iron bush, which is itself keyed to the shaft.

No attempt has been made to represent the interior of the engine-house because the gearwork would be so minute. Several different forms of gearwork were used on these engines; one worked as follows:—A simple tappet-operated gear provided for steam and exhaust, but without expansion; this, a point on which Cornishmen were always very keen, was provided for by means of a valve on the steam supply which opened twice per revolution, just at the beginning of each stroke. A shaft leading into the house, and driven from the crank by two small bevel-gears, represents a shaft for driving the indicators used on winding engines to show the position of the cage in the mine shaft.

Unlike the pumping engine, the winder has caps on the bearings on which the beam rocks, while the bearings themselves are held down by four long bolts, two inside the house and two outside. The bottoms of the two side pairs are attached to two plates that pass through the bob wall, about level with the bottom of the plug door. A little of the weather-boarding at the top of the house is cut away to show one of the bearings and its supporting stool.

The connecting-rods were usually called sweep-rods, but varied in design. Cast-iron maltese-cross section-rods were common, especially on older single-acting engines, because the weight of a heavy sweep-rod would help to make the outdoor stroke. In later double-acting engines where a somewhat faster speed was attempted, wrought iron rods were used. This type of rod has been used on



Another view of the model, showing the buildings.

the model; one of the photographs shows the open-work construction of this form of rod.

A common practice in Cornwall was to build the chimney stack on to one corner of the house. This has been adopted in the model winder, but not in the pumping engine, so as to show the two different arrangements. For a similar reason, wood lintels, instead of brick arches over the doors and windows, have been used on this model.

A small a.c. motor inside the base drives the engine at a slow speed when it is desired to show it at work.

While some might decry a steam engine that has to be driven by a motor, the writer would add, as a last remark, that he considers a representative model of this kind to have at least some historic value, and at any rate a scenic attractiveness, not found in purely mechanical models.

Photo by] [*W. K. Andrew, St. Austell*

A Cornish winding engine converted to a rotary pumping engine. Note the lugs on the flywheel spokes; these were where one side of the drum had been attached.

Making Use of Short Tools

IN nearly every model engineering workshop, and around the larger lathes in the engineering factories, are to be found short pieces of tools which have become too small to hold firmly and safely in the tool-rest. Most of them have been put aside in the hope that they will "come in" for some job in the future.

I had several such tools which I utilised by welding a bar of mild steel, of the same section as the tool, to each piece, the mild steel in each case being long enough to give them the necessary length to hold securely in the tool-rest. This method of using up the whole of the tool can also be applied to planing and shaping machine tools.

If the tool requires drawing out, it should be done, if possible, beforehand. In the case of a water-hardened tool it should not be hardened and tempered, because the heat set up by the welding only softens it again. The reason why the tool should be drawn out first is that the hammering needed to forge the tool to shape may crack the joint and even cause it to break and fly off.

The opposite end to the cutting edge of the tool is next ground; bevelling the edges down even on all four sides, so as to form a section similar to that of the tool. This is also done to one end of the M S. bar.

To weld them together, place the two pieces in position on a flat surface, with the two ground ends touching and so forming a "V," down which the electric welding is run in the ordinary way, using whatever electrod is considered best by the welder. I believe there is an electrod made by Murex Electrod Process for this particular job of welding M.S. to tool-steel. It has never been used to weld my tools; in any case, the ordinary rod does all that I require of it.

Next comes the cooling off; if the steel being used is self-hardening, to put it on a cold stone floor is all that is needed. The water-hardened tools will, of course, have to be rehardened and tempered.

When the tool is cool the welding on the bottom must be ground level so that it will be flat. On any side where it is not essential to have a flat surface, the welding may remain untouched, as it gives the joint extra strength.

It is not advisable to tighten down on the welding, as sometimes it is hap to cause the welding to break. These tools can be re-forged, but it must be done carefully and by an expert blacksmith. With these welded tools, jobs of all types and materials can be carried out successfully.—P.T.P.

Some of my Early Model Engines

A Few Ordinary—and Extraordinary—Models of the 'Nineties

By B.C.J.

PERHAPS there are not a few readers of THE MODEL ENGINEER whose interest in making and running engine models dates back to a period a little in advance of the opening of the present century: to those peaceful years, in fact, now usually referred to as "the 'nineties." Such people will, one thinks, derive a certain degree of pleasure from the perusal of a few notes and recollections

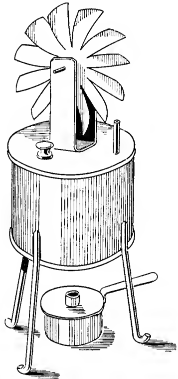


Fig. 1. "My first steam engine."

from the pen of one who (if he can claim nothing further) *does* claim to have been a model engine enthusiast from his earliest schooldays right down to a time at which technical training was presumed to be complete.

And as for the younger man, let him derive from these notes what pleasure he may from a realisation that the present-day model engine-lover is catered for in a far more satisfying manner than was his father, or any contemporary with him. For it may well be that certain of the rather unusual models illustrated and described hereafter may appeal to him as little else than curiosities, or even monstrosities.

(Let me here remark, before proceeding, that these memoranda are of so personal a character that it seems best to deal with them in the first person. And this I shall do.)

If the reader would care to turn up the December 5th, 1940, issue of THE MODEL ENGINEER, he will find on the front page the following words: "My first steam engine was simplicity itself. It consisted of a vertical pot boiler, heated by a methylated spirit lamp underneath. On the top of the boiler was mounted a wheel with vanes, this being in a vertical plane, and carried on a wire axle running in two plain bearings. A small pipe or nozzle projected from the top end of the boiler and from this, when the water boiled, a jet of steam impinged on the vanes of the wheel and drove it round. . . ." And then follow further interesting details of this steam "turbine."

The writer of the above quoted informative remarks was, of course, Mr. Percival Marshall himself, and it is a curious coincidence, perhaps, that what Mr. Marshall describes as his "first steam engine" was quite clearly one and the same thing as my own "first steam engine." I am sure the gentleman mentioned will easily recognise the model

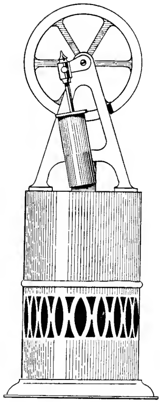


Fig. 2. A small steam engine frequently put to work by David Joy—to amuse and instruct his family.

depicted in Fig. 1, which is, by the way, drawn from memory only.

My own example of the engine, packed in its cardboard box with a highly coloured label, was purchased at a wonderful toyshop that used to be situated not far from

that very intriguing glass-house of amusement (the Crystal Palace), a place of many pleasant memories, but now—alas! no more. I cannot forget the exquisite delight of walking out of that shop with the "engine," it certainly did not look much like one, tucked under my arm; nor the delight of first listening to the hiss of steam issuing from the nozzle and regarding the rapidly revolving fan-wheel.

I think Fig. 1 gives a sufficiently good idea of the characteristic features of this pristine purchase, nor would a technical description be possible, of a machine having so ridiculously few parts, moving or otherwise. I doubt, however, whether so good a shilling's worth can be had even now, in these days of mass production.

Two Vertical Engines

There is a remarkable fact concerning many of the small steam engines of the period under review, viz. that, generally speaking, they did not resemble any kind of engine in practical use in the factory, on the railway or elsewhere. Indeed, many of these small machines suggested, as was probably the case, that they had first seen the light of day in some optician's workshop. Most of the small brass parts were just such as might have formed parts of small microscopes or other optical apparatus. The optician could not, in truth, be expected to possess much knowledge of engines and engine design; a model engine to him would be just a scientific toy, nothing more.

However, one of these scientific toys *did* come into the possession of our family, and it was the delight of my father, David Joy, to amuse us boys by getting up steam and giving the engine a run round. This momentous occasion always occurred on the same day of the week and at the same hour, after dessert on the Sabbath. The engine would be placed upon a plate for safety's sake, hot water would be procured and a small quantity of sweet-smelling, so it seemed to me, methylated spirit poured into the lamp. The application of a match would be followed shortly by the sizzle of escaping steam and very soon the little engine would commence to revolve, making a considerable clatter in the process and spitting steam and water from a diminutive exhaust port.

This engine is, I believe, rather accurately delineated in Fig. 2. It will be noticed that it had a single-acting oscillating cylinder, a flywheel and crankshaft supported on two A-frames, a vertical boiler supporting the A-frames and a much-beperforated furnace beneath the boiler. (I believe these perforations are correctly indicated on the drawing.) The boiler had a rather attractive bronze finish and the brass parts were polished and lacquered, microscopically, so to speak.

I think it will now be admitted that the miniature oscillating cylinder of the late Victorian period suffered from two grave defects, the *packed* piston and the spring-held ported face of the cylinder. The packed piston either leaked or gave rise to excessive friction, or both. If the piston was perfectly steam-tight, the boiler pressure was generally insufficient to make the engine budge. If the piston was, like the sailor, free and easy, then the boiler capacity was insufficient to provide driving force and to make up leakage at the same time. So it was once again an instance of "the devil and the deep blue sea."

A rather similar state of affairs occurred in regard to the ported oscillating face of the cylinder, viz. leakage *versus* friction. The spring drawing the faces together was too short and stiff, and inelastic. A longer and larger diameter spring would have helped matters quite considerably.

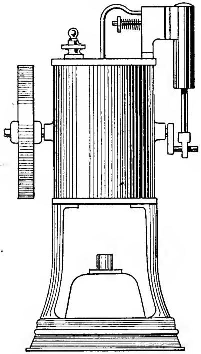


Fig. 3. A small brass-boilered vertical engine, probably of Continental origin.

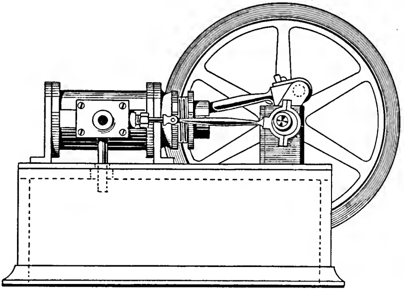


Fig. 4. A horizontal "trunk" engine of unusual design.

The next little engine, represented in Fig. 3, came into my possession in my early schooldays, whether by direct purchase or exchange I do not remember. It had a brass boiler, so that it would last a lifetime (if necessary). There was a "fitting" piston to the small oscillating cylinder so that the vexed question of friction *versus* leakage did not arise. A small shaft, carrying a lead flywheel at one end and a crank at the other, worked inside a tube passing clean through the boiler, which might have been the cause of hot bearings, but wasn't. As for boiler fittings, well, there was just a safety-valve.

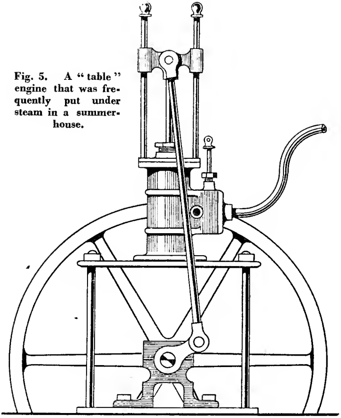
The engine was no doubt of Continental origin, it was well made and finished and it may indeed have been one of the first mass-production toys, which were later to flood this country so considerably. I cannot omit to say that

getting up steam and running this little model afforded me much amusement during a severe attack of the mumps, so that the engine has associations of swellings, mumps and oranges.

Two Unusual Types of Engine

The horizontal engine shown in Fig. 4 was assuredly *not* a mass-production product, for I doubt whether more than one was ever constructed. Strictly speaking, it was not of the 'nineties, but of a much earlier date. It had indeed been built for, or by, my father, and I think I must have purloined it.

Fig. 5. A "table" engine that was frequently put under steam in a summer-house.



It was a *trunk* engine. It was to some extent double-acting, for the diameter of the trunk portion of the piston was somewhat less than that of the piston proper. (Probably the cross-sectional area of the trunk was *half* that of the piston.) Any reader who has followed me so far will at once notice the possibility, nay the probability, of a great deal of leakage past the trunk. Well, there *was* a great deal of leakage past the trunk! Steam blew out in clouds on each in-stroke, so much so indeed that the in-stroke of the piston hardly counted, for little did it add to the power of the engine. Amongst countless attempts, I only discovered one method of stopping this leakage, viz. that of screwing up the gland of the stuffing-box so tightly that it stopped both leakage and engine. This was not satisfactory, however. So the engine continued to leak and indeed it leaked its way to the scrap-heap.

Other features were that both the connecting-rod and the eccentric-rod were, to an extreme extent, of the "fish-belly" pattern; that the cylinder was a built-up one, the flanges and steam-chest being separate pieces sweated to a brass tubular cylinder and that the big-end of the connecting-rod was of the strap and cotter type.

The engine was mounted on a wood box-bed, into which the exhaust, as much of it as had not previously leaked, was discharged. Still, with all its faults, this quaint old engine (I still have a few pieces of it) provided me with a considerable amount of amusement. I remember that I even tried to convert it into a *gas-engine*, but in this I was not successful.

The next engine to receive the attention of my pen belonged to my grandmother. This sounds a little strange and I do not mean to infer that the old lady ever raised steam in the boiler. I don't think she did. The engine normally reposed in a certain store-room of treasures in the rambling old house where, for many years, lived my grandmother, and where I frequently made stays of short duration. The engine, which is illustrated in Fig. 5, is the type of machine known as a "table" engine, presumably because the cylinder and other parts were fixed to a table-like structure supported on four columns. I think this machine represented fairly closely a type which was in considerable use early in the last century. (There are several model specimens at the Kensington Science Museum.) I cannot recall how the valve-spindle was connected to the eccentric on the crankshaft, so I have omitted this part of the mechanism. Connecting-rods were, of course, duplicated: the one on the far side being connected to a double-webbed crank, if my memory is not at fault. The boiler was of "saddle" type and steamed none too well. The only other facts that I can call to mind regarding this piece of machinery are, firstly, that its condition strongly suggested moth and rust, and age and neglect, and, secondly, that in order to raise steam in safety (safety from my grandmother that is), it was desirable to carry the engine and boiler bodily down to the far end of the garden where there was a convenient summer-house and where I could, indeed, blow myself up to my heart's content.

Two or Three Locomotives

The first *locomotive* engine that came into my possession, when I was aged about ten, was purchased for the sum of three shillings and sixpence. There used to be somewhere in London a firm of the name of Theobald (?) who issued a price-list of all sorts and kinds of things calculated to

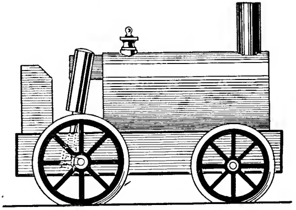


Fig. 6. A miniature steam locomotive fitted with a single cylinder only.

attract odd silver from the pockets of schoolboys. This locomotive (Fig. 6) was one of the attractions. Funds had reached a low ebb (three shillings), but I expect that an odd pocket knife or a few foreign postage stamps brought the missing sixpence.

(To be continued)

A Machine Tool Bench

By J. Handel

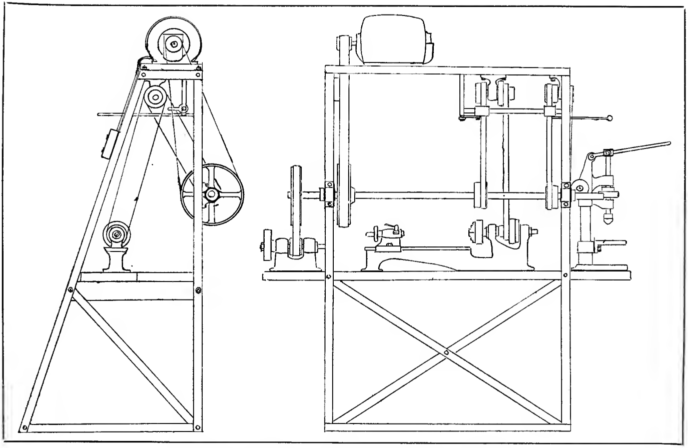
THIS bench, if such it may be termed, was designed to provide a compact and fairly portable mounting for a 3-in. lathe, a sensitive drill, grinding-head and, eventually, I hope, a small horizontal milling machine.

My original workshop was a portable wooden shed and when funds allowed an expansion of my "shop," it was soon apparent that such a structure was not designed to carry any sort of countershaft. At about this time I visited the workshop of an acquaintance, and there saw a combined bench and overhead gear which sowed the seed of the idea which resulted in the present design.

Basically, the bench consists of two end frames of the shape and dimensions shown in the drawings. These end frames are riveted up, and were fabricated of $1\frac{1}{2}$-in. angle iron. At a suitable height from ground level two pieces of channel steel from an old car chassis were fitted to carry the bench itself, which is of $1\frac{1}{2}$-in. timber.

Top and bottom of these frames were joined by suitable engths of $1\frac{1}{2}$-in. angle iron, but these were bolted on to permit rapid dismantling of the bench, should this become necessary at any time. Various tie-rods were fitted to stiffen the structure, and it has been found quite rigid in use.

The main countershaft was carried in plain brass plummer blocks bolted to the rear uprights, while the $\frac{1}{2}$-h.p. electric motor which supplies the power was bolted to a 1-in. plank, fitted between the two upper cross-members. Also bolted to this plank are the countershafts for the lathe and sensitive drill. These are complete with fast and loose pulleys and striking gear.



Side and rear elevations of Mr. J. Handel's machine tool bench.

The lathe is mounted centrally on the stand, while the drill is on the left, with the grinding-head on the right, but it is hoped that some day this position will be occupied by a milling machine of home manufacture, the design of which is complete and for which certain patterns have been made.

This set-up has been found most satisfactory, and that it is portable is witnessed by the fact that it was moved to its present position in a 10 h.p. car.

MY WORKSHOP

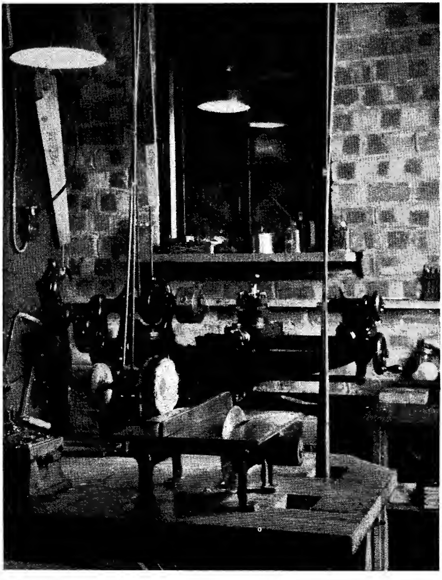
By P. T. Atkinson

THIS is situated in one end of a brick-built garage measuring 16 ft. long × 8 ft. wide, the workshop occupying a space 8 ft. square, access to same being obtained by a side door.

The equipment consists of the following machine tools:—

The lathe, which is, of course, the main item, is a $3\frac{1}{2}$-in. Drummond lathe of "last war" vintage, equipped for treadle drive in the event of power failure. I have constructed a 4-tool turret in place of the standard top slide and find it very useful and convenient. I also have a number of "A" size split chucks with an adaptor for same which fits in the No. 1 Morse hole in the mandrel. I find these chucks very handy when machining loco. pistons, rods, etc. A further accessory is a vertical slide for milling operations.

Drilling machine. This is a high-speed sensitive type drill which takes drills up to $\frac{1}{4}$ in. diameter. This is driven from a small sub-countershaft mounted in ball-bearing plummer-blocks. These plummer-blocks consist of two pieces of hardwood screwed together, and recessed to take the ball-race. The ball-races are "Skefko" type 6203 light metric, and were obtained from "Ford" 10 h.p. engine fly-wheels. They were originally used as a tail support for the clutch shaft and dimensions are as follow: 40 mm. outside diameter; 17 mm. inside diameter; 12 mm. through inner race. I should add that these bearings are of combined thrust and journal type.



A view of the workshop from behind the "Fitting Bench." Motor starting switch can be seen on side of "Tall" cupboard.

The driving pulley of this crankshaft was removed from an old sewing machine, and consequently on slackening the locking-ring the drill can be disconnected.

Hand planing machine. This machine was purchased second-hand for a very moderate sum and is quite a useful little tool. (See small photograph on next page). The table measures 14 in. long × 5 in. wide, and will accommodate work up to a maximum height of 4 in.

The toolbox has a proper "clapper," and also has a swivel motion for giving side relief. I intend fitting an "auto-ratchet" feed to the cross-slide at a later date.

Polishing and grinding head. This is just a plain affair equipped with a 6-in. Calico Mop at one end of spindle and 4-in. "Aloxite" wheel at the other. A small $\frac{1}{4}$-in. drill chuck is also fitted on the "stone end" of spindle.

6-in. saw bench. This is of my own design and construction, and if of sufficient interest, I shall be pleased to give fuller details (Editor permitting). The saw blade is 6 in. diameter, and the table, of $\frac{3}{8}$-in. plate, is 12 in. long × 10 in. wide. I was fortunate in having this plate finished on a surface grinder.

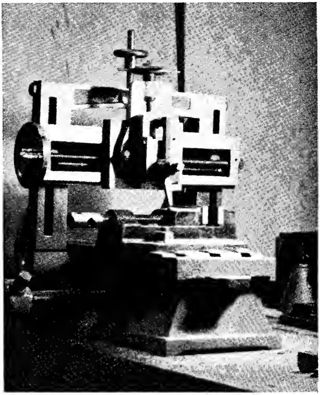
The side frames were cast in Mechanite (semi-steel) from my own pattern, and subsequently machined up with the aid of the lathe and planer. The spindle runs in ball-bearings which are the same as those used in the

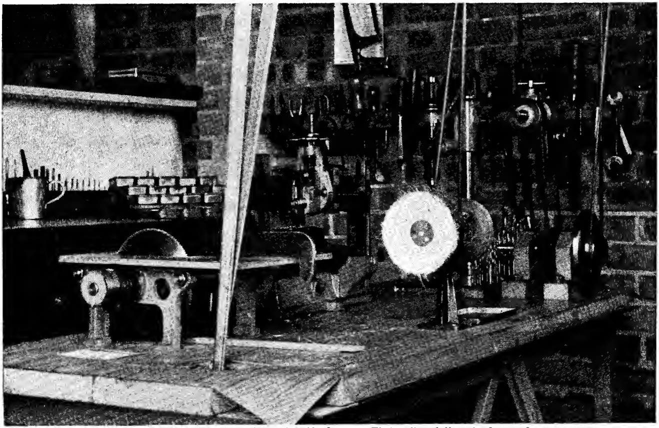
drilling machine countershaft. Drive is taken direct from the motor via $\frac{1}{4}$-in. diameter round belt which passes through a hole cut in the bench top. When the saw is used, the main belt to countershaft is disconnected. Power is supplied by a $\frac{1}{4}$-h.p. split-phase a.c. motor running at 1,425 r.p.m. This is mounted on slide rails fixed to the floor and situated under the bench. These slide rails are composed of $\frac{1}{2}$-in. diameter bright steel rods mounted in angle-iron supports.

The motor drives a "high-speed" countershaft running in ball-bearings at 712 r.p.m., fast and loose pulleys being provided for starting and stopping. This "high-speed" shaft provides power for the drilling machine and grinding-head and is connected to a second countershaft running at 300 r.p.m. This "slow-speed" shaft, which runs in plain self-aligning cast-iron hangers, drives the lathe, and is also fitted with fast and loose pulleys. Both shafts are 1 in. dia. and are hung from the cross timbers supporting the roof.

The ball-bearings for the "high-speed" shaft are second-hand from a scrapped car and are mounted in hardwood blocks, which are split across their horizontal centre line. The clamping bolts also serve as fixing bolts and pass through the roof supports.

With regard to the layout of the "shop," it will be seen that the bench carrying the drilling machine, etc., is placed mid-way between the "fitting bench" and lathe, and consequently, the grinder is handy for touching-up lathe tools, a half-turn of the body from the lathe being all that is necessary when tools become dull. Similarly, the drill is just as convenient in relation to the "fitting bench." This latter bench is quite a useful affair, being fitted with seven drawers at one end, and a decent-sized cupboard at the other. The top drawer is partioned off and used for storing material, the others for drawings, catalogues, etc.





View of workshop from the side-door. "Fitting Bench" in background.

★ Small Capstan Lathe Tools

Notes on " tooling up " for repetition work, with special application to the small capstan attachment recently described in the " M.E."

By " Ned "

Running-down Tools

THE process of reducing the diameter of work, by means of tools applied axially from the capstan head, is generally referred to as " running down," and is one of the most common operations in capstan lathe practice. In such components as screws and bolts, the running down of the shank, to a more or less exact diameter for subsequent screwing, constitutes the heaviest single operation, and in many cases it is necessary to remove the major part of the material in performing it. There are several forms of running-down tools, all of which have their particular merits and limitations, some being best suited to very heavy cuts, while others are capable of producing work of high accuracy and finish. In order to ensure that both the cutting efficiency and accuracy produced by the tool is independent of the inherent rigidity of the work, it is common to equip the running-down tool holder with some form of steadying device, which travels with the tool point, either in advance of or slightly behind it.

Plain " Knee " Tool Holder

This is the simplest form of running-down tool holder, which is not equipped with any form of steady, and is therefore only applicable to work which is known to be very firmly held in the chuck, and sufficiently rigid in itself to stand up to the required cut without perceptible deflection. It is most useful on work of comparatively large diameter, as the holder, unless specially designed for the purpose, is not adapted to withstand heavy frontal (axial) load, and therefore may tend to spring when taking deep cuts. The accuracy of work produced by this form of tool, in respect of diametral dimensions, depends on its own inherent rigidity and that of the work itself, in conjunction with the accuracy of indexing which can be obtained on the capstan head. This is a most important point, which is sometimes overlooked by operators and setters, but it will be obvious that if the capstan head, by reason of wear on the locking bolt, or other causes, cannot be relied upon to index to an undeviating angular accuracy at the particular station where the holder is used, any error in this respect will be multiplied at the tool point, and thus produce varying diameters on successive samples of work. Care taken in eliminating backlash when indexing the capstan will reduce the effect of such error, but it is fairly certain that this form of tool is not the one best suited to producing work to close limits of dimensional accuracy.

In large capstan and turret lathes, " knee " tools are often used in conjunction with an overhead steady bar, attached to and extending from the lathe head-stock, which engages with a close-fitting bush on the tool holder, and guides it in true axial alignment and location relative to the lathe axis. By this means the inaccuracy referred to above can be almost or completely eliminated. The method is, however, scarcely applicable to the lathes and the class of work which we are now considering, being mentioned only to illustrate possible means of improving accuracy; but in the case of work which has a hollow centre, there is a practical method of improving accuracy by the use of a pilot or " plug " steady, which will be referred to later.

Fig. 6 shows a simple form of " knee " tool holder suitable for the machines and the class of work now under discussion. The angle bracket which holds the tool may be cut from

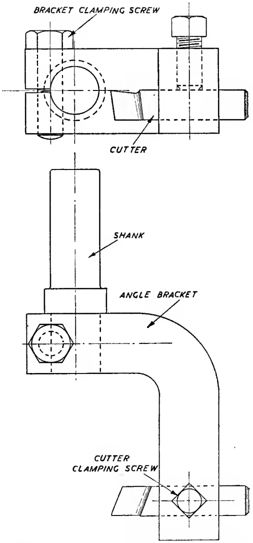


Fig. 6. A simple form of " knee " running-down tool.

the solid rectangular bar, or bent up from square material, according to which is the more convenient, and is made of a size and shape to accommodate the radius of the work to be dealt with. It is not advisable to make the tool capable of dealing with an abnormally large diameter of work unless

* *Continued from page* 333, " *M.E.*," *October* 23, 1941.

it is definitely required or anticipated, as the rigidity of the cutter will suffer when it is set for working on smaller diameters. The bracket may be clamped or otherwise attached to the shank, and the hole for the cutter may either be set square with the axis, as shown, or sloped forward for greater facility in dealing with the machining of shoulders, or getting close up to the chuck.

An important point in the design of tool holders which are not equipped with steadies is the avoidance of unnecessary overhang from the capstan head. The distance of the actual tool point from the point of support should be kept to the bare minimum necessary, and the components of the holder built as stiffly as possible. As there is bound to be a certain amount of spring in the stalk of the holder, there is much to be said for eliminating the latter, and mounting the holder by means of a flange bolted to the face of the capstan head. This, of course, can be done fairly easily when a polygonal capstan head is used, and constitutes the principal advantage of the latter over the round head, which has hitherto been the more popular on

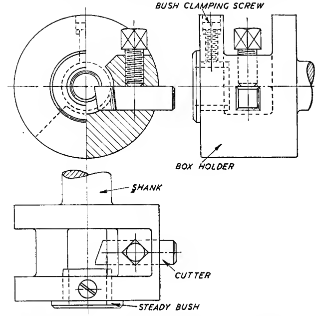


Fig. 7. Box type running-down tool with bush steady.

the smaller types of capstan lathes. Flange mounting of the holder is now almost universal practice for heavy work, and practically all large capstan and turret lathes have polygonal heads.

Box Tool Holder with Bush Steady

The simplest form of running-down tool holder incorporating its own steady is the " box " tool, which is made in a wide variety of forms, and is most popular in screw-making and similar light production, of the class in which readers are most likely to be interested. Fig. 7 shows a tool of this type, in which the steady takes the form of a hardened steel bush, which is located in advance of the tool point, and is a running fit on the outside diameter of the stock being turned. It is thus only suitable for use on bar work, in which the stock is fairly accurate to size and runs truly in the chuck, or alternatively, for work which has already been run down over the outer diameter in a previous operation. The bush must, of course, be made up to suit the size of work for which it is to be used ; it is common practice to make up a set of bushes in stock sizes, so that the tool is adaptable for various jobs at short notice.

In the form of holder shown, the cutter is simply clamped in a square cross hole in the body, and thus the adjustment of the size of the finished work is a somewhat haphazard procedure. The provision of a more elaborate method of feeding the tool in, for initial setting of diameter, is, however, at the option of the constructor ; but it is worth while to mention that comparatively few such holders used in production practice are equipped with any such adjustment. Capstan tool setters acquire considerable skill in setting cutters to fine limits of precision, simply by partially slackening the clamping screw and tapping them lightly through the hole in the holder.

In most work to which this form of holder is likely to be used, it is capable of reducing the stock in a single cut and leaving it with a good finish, fairly accurate to size. If special accuracy is necessary, a second cut with a finishing tool in another holder may be advisable ; but it should be noted that it will be impracticable to use the same form of steady for the finishing tool, as it cannot bear on the outside of the stock, and if fitted to bear on the turned-down portion, it will prevent the cutter from running right up to the shoulder.

Despite its limitations, which have caused it to lose popularity in modern practice, this simple form of tool is capable of quite good work in intelligent hands, and it may be mentioned that its use need not inevitably be associated with capstan practice ; it could be used in the ordinary lathe tailstock, as a rapid means of accurately sizing small work. It always runs down the work concentric with the outer diameter, unless forced out of truth by heavy work badly chucked, and it may be used on long, slender bars without fear of chatter or inaccurate sizing. The bush steady gives little trouble and wears quite well if it is properly finished and hardened, and kept lubricated with oil or cutting compound when in use ; it even has some merit as a burnishing tool, especially if heavy cuts are taken. Some forms of this tool are liable to give trouble by the packing of the swarf as it comes off the cutter, but this can usually be overcome by modifying the design of the clearance space, or the shape of the cutting edge. The cylindrical form of holder shown is the simplest type to make, but in some cases it is desirable to allow more room in the aperture in the box, at the back of the cutter, for the above reason.

(To be continued)

For the Bookshelf

The Lathe Operator's Manual. By Richard Hilton. London : Sir Isaac Pitman & Sons Ltd. Price 6s. ; postage 3½d.

This book is intended principally as an introduction to the use of lathes of the type employed in engineering industry, including centre lathes of various types, turret and other forms of manufacturing lathes. It deals with the design and mechanism of these machines, cutting tools and accessories used in conjunction with them, tool layouts and methods of dealing with typical examples of work. A chapter is devoted to reference data and calculations applicable to lathe practice, including conversion of fractions to decimals, inches to metric measure, r.p.m. to peripheral speeds at various diameters, and calculations of change-wheels for cutting English and metric threads. The subject matter is of interest to the professional rather than the amateur lathe operator, and should be particularly useful to trainees or other beginners in engineering machine shop practice.

Letters

Lathe Design

DEAR SIR,—I have been interested in reading the letters from R.V.B. and Mr. Cruttenden in recent issues, as they reopen a subject which was ventilated at some length in your pages some years ago.

Having a fairly wide acquaintance with model engineers, I have formed the opinion that their requirements are so many and varied that it would be impossible to embody a tenth of them in any one lathe. Were lathe makers to start competing by providing one or more of the special features demanded, up would go the prices, and we should be little better off, since the new features might not appeal to many purchasers, who might wish for something quite different.

Surely it is better for manufacturers to concentrate upon producing the best quality lathe at a reasonable price. There are (or were, until restriction came) some splendid tools on the market, and also many not so good. For my part I would rather spend an additional fiver to get a properly ground and well-fitted mandrel than a milling attachment or some other apparatus of that type. Gadgets and attachments can be made by the owner of a good lathe, and provide scope for the exercise of skill and ingenuity.

As R.V.B. resides in my vicinity, perhaps he would care to contact me so that we could argue this matter at our leisure.

Yours faithfully,

West Wickham. ALEX. B. STORRAR.

DEAR SIR,—I was interested to see R.V.B.'s letter on the subject of lathe design and must agree with him that in the past there have been abortive efforts to get a useful discussion going and so far no useful results have been forthcoming.

No wonder! I cannot recollect a single instance in which the £.s.d. of the matter was even so much as hinted at. To quote R.V.B. " Before anything can be put on paper, there are some points which need to be cleared up." Now I take it we shall be discussing a commercially-built lathe, therefore the " one or two points " become " one point," and a big one at that, to wit: how much is anyone prepared to pay?

This seems to me to be the crux of the whole palaver.

I am a little hazy as to exactly what R.V.B. means by suggesting " we should forget accepted practice." If it infers forgetting accepted lathe practice, then Heaven forbid! You may be sure the lathe manufacturers are not likely to forget it, and are not likely to award any medals for schemes which appear to them as something of a cross between a bicycle and a harmonium. So, time spent on evolving designs which do not conform to accepted practice, so far as the essentials of design are concerned, will be well and truly wasted, since no manufacturer would take the risk of building to such designs.

I suggest, Sir, that for any discussion to be useful it must centre round a tool to be constructed on proved and accepted lines; and it is further suggested, as I believe someone has done in the past, that the tool should be available (when built) either in simple form or with one or more items of additional equipment according to a plan which might form a basis for discussion, this equipment to be available as part of the general specification; provision for such additions to be made in the design.

But first, for goodness sake, let us fix a price limit.

Yours faithfully,

" TUBAL CAINE."

Expansion in Model Cylinders

DEAR SIR,—In your issue of October 9th, " Churchwardian " is another who is convinced that steam can be used expansively in model cylinders. I, personally, am convinced that I have proved it is possible.

All of us know that a small scale model is most unrealistic on being started up. Condensation is tremendous, but once the cylinder or cylinders get hot there seems to be no trace of excessive condensation. On both my model ships and locomotives the exhaust is perfectly dry. The proof of that is that the engines slow up if the lubrication fails.

Like " Churchwardian," I have definitely proved that by giving lead and an early cut-off the water consumption in the boiler is reduced, and in several cases pressure in the boiler has risen and increased power has resulted.

If, therefore, all these phenomena are due to some other cause, I also ask Mr. H. Greenly to give us the theory on which he bases his statement. I am not making this demand in an unfriendly way, because Mr. Greenly and myself are friends of many years standing. He must have some reason for his statements, and whether right or wrong, I am sure all of us would be very interested to read them.

Yours sincerely,

Bishop's Stortford. VICT. B. HARRISON.

The " Midge " Loco.

DEAR SIR,—I was very interested in your reference in " Smoke Rings " to the " Midge," particularly with regard to the question of cylinder lubrication.

I recently acquired a partially completed model from Mr. E. M. Thomas, of Barnsley. Mr. Thomas had made a very fine job of the chassis and I hope to be able to complete the locomotive, as time allows, to the high standard he has set. He had provided a pair of mechanical lubricators, each consisting of an oscillating cylinder in a rectangular oil box operated by a ratchet arm, the pump pistons being about 5/32 in. in diameter. I believe that these lubricators are of " L.B.S.C." design. I intend to connect them direct to the steam chest of the cylinders through $\frac{1}{8}$ in. Bassett-Lowke check-valves.

I fitted a pressure gauge on to one of the lubricators and a couple of flicks of the ratchet arm gave a pressure of about 80 lb. per sq. in., so there should not be much doubt about their ability to provide oil in small but regular doses.

As a point of interest, Mr. Thomas had departed in the boiler design from Mr. Gentry's layout, and has provided two 1 in. diameter tubes, so that a moderate degree of superheat can be obtained by inserting two spearhead tubes. This, of course, has a bearing on lubrication, and makes it even more necessary that this should be adequate and reliable.

Yours faithfully,

Stanmore. G. H. BUCKLE.

DEAR SIR,—I was much interested in the " Smoke Ring " in THE MODEL ENGINEER for September 25th, entitled: " A reader's problems regarding the 'Midge' loco."

Mr. George Gentry has recently consulted me *re* the two points mentioned, viz., the proper fitting of motion pins, and the lubrication of the cylinders and valves

I quite agree with your correspondent that motion pins, etc., should be fitted without having the slightest shake or lost motion, but should at the same time work with perfect freedom. This desirable state of affairs is quite possible of attainment by any model engineer of reasonable skill.

So Mr. Gentry has in course of preparation an article on this subject which I am sure will satisfy your correspondent and others who are similarly interested.

Regarding the cylinder and valve lubrication of the " Midge," Mr. Gentry has also in preparation an article and

drawings for a very successful and reliable lubricator for this loco., and of a type which I can, from long experience of same, confidently recommend.

Just one other point about the "Midge": there have been complaints—and very justifiable ones at that—from some builders of this loco., that the cylinder castings which they have obtained or have been offered, are not of the same design and construction as those shown in the drawings in THE MODEL ENGINEER. As it is most essential to performance that the cylinders should conform to the published designs, such readers should write to Mr. Gentry, c/o. THE MODEL ENGINEER. He has the original patterns for these cylinders and accessories, and can advise where genuine castings from these patterns may be obtained.

Yours faithfully,

Epsom. G. S. WILLOUGHBY.

The "Gearless" Car

DEAR SIR,—It was not my intention to butt in on the correspondence in the recent issues of your paper regarding the above, but in view of your Editorial note to Mr. Poyser's letter in your issue of October 9th, I looked the matter up. In "The Autocars of 1908," issued by *The Autocar*, the "Owen Gearless" car is given, made by the Owen Motor Company, 1, Long Acre, W.C.; these people made four types of car, the two smaller 25 and 35 h.p. were of the orthodox type, whilst the 40 h.p. was called the "Gearless." It had a four-cylinder engine with a R.A.C. rating of 32, the bore and stroke being 115 and 135 mm. respectively; it was shaft driven without gearbox, although I presume some provision must have been made for reversing. I have not the details of 1909 cars, but the "Gearless" does not appear amongst the 1910 cars.

The fourth car made by the Owen Company was the "Owen-Petelectra," which incorporated the Germain system of electric drive and was the forerunner of the "Crown Magnetic" described by Mr. Poyser. I was very surprised to see this car at the Show brought out as a new car, in view of the fact that the Germain system is very fully described in *The Automobile*, vol. 2, published by Cassell in 1905.

With regard to the "Valveless," this was also in being in 1908 as a 20 h.p. 2-cyl. car with a R.A.C. rating of 22, and was made by Valveless Ltd., of King's Lynn. In 1910 they made a 25 h.p. two-cyl. car, 5¼ in. bore, 5½ in. stroke, two-stroke engine with two crankshafts and flywheels geared together, the address of the firm now being the Valveless Car Co. Ltd., 4, Princes Street, London, W. In 1914 there were two valveless models on the market, a 15.8 h.p., and 19.9 h.p., both with two-stroke engines, the makers now being Dodson Motors, the proprietors of which were David Brown & Sons (Huddersfield) Ltd.

There have, of course, been several methods of drive eliminating the gearbox; most of these were Continental. Of the friction drive models the Friedman and the Maurer-Union were two of the best known and dated back some years before the G.W.K. existed; there was also the "Dougal," made in Leeds, which was, I believe, one of the first in this country to adopt this system.

One of the most peculiar drives was one fitted to the "Hagen" petrol lorry, the transmission of which (quoting from the description) "consists of a link motion, which imparts a varying motion to rods which drive the differential on the live axle through reciprocating clutches acting alternatively, one driving whilst the other runs free."

I should advise anyone interested in old cars, whether petrol, steam or electric, to try and obtain a copy of *The Automobile* mentioned above, as it is crammed full of interesting matter, and there is more on steam cars than any work I know of.

Yours faithfully,

Teddington. ARTHUR W. FITHIAN.

Clubs

The Society of Model and Experimental Engineers

There will be a Rummage Sale in The Workshop, 20, Nassau Street, London, W.1, on Saturday next, 8th November, at 2.30 p.m. In view of the existing shortage of materials and small tools, members are specially requested to bring any surplus they may have to the sale.

Full particulars of the Society may be obtained on application to the Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

The Kent Model Engineering Society

The next meeting will be held on Sunday, November 9th, at 11 a.m., at Sportsbank Hall, Catford, S.E.6. Mr. Clements, of the Croydon M.E. Society, will describe the making of his Ciné projector and also show one or two films.

At the following meeting, November 16th, Mr. Rowland will talk about his new locomotive.

Particulars as to membership from Hon. Sec., W. R. COOK, 103, Engleheart Road, Catford, S.E.6.

The Junior Institution of Engineers

Saturday, 8th November, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m., Informal meeting. Paper, "Mills and Mill Gearing," by Rex Wailes (Member).

Saturday, 15th November, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m., Annual General Meeting.

Saturday, 29th November, 1941, at 39, Victoria Street, S.W.1, at 2.30 p.m., Ordinary meeting. Paper, "The Engineer and the rest of the World—a study in relationships," by K. S. Jewson (Member).

Altrincham Model Power Boat Club

The next meeting of the above club will be held at the following address on Sunday, November 9th, commencing at 2.30 p.m. Hon. Sec., O. B. BATES, 2, Hereford Villas, Hereford Street, Sale.

York and District Society of Model Engineers

The next meeting will be held on Friday, November 7th, 7.30 p.m., at 26, Longfield Terrace, York. H. P. JACKSON, Hon. Sec. *pro tem.*, 26, Longfield Terrace, York.

Norwich and District Society of Model Engineers

The next meeting will be held on Thursday, November 6th, at 7.30 p.m., when Mr. A. J. Warren will talk on "Mesopotamia."

Hon. Sec., J. POWELL, 29, Spinney Road, Thorpe, Norwich.

NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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